



Weather Impact Decision Aids for Mission Planning and Execution

Capt Dana M. Madsen
Battlespace Environment Division
AFRL Space Vehicles Directorate
(Formerly Phillips Laboratory Geophysics Directorate)
617-377-2963 or DSN 478-2963
madsen@plh.AF.mil



Overview



- Concept
- Benefits
- Products

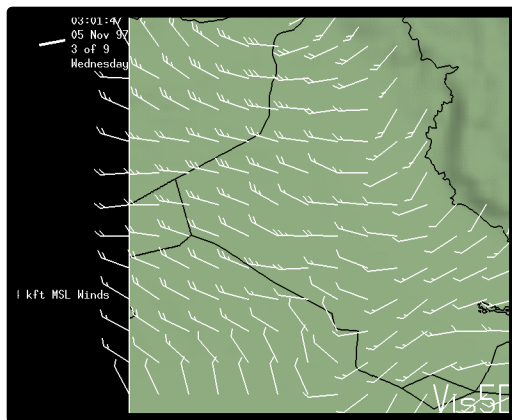


WIDA Concept



*Translate Raw Meteorological Data into
Products Readily Assimilated by the Warfighter*

Raw Weather



Tailored



for the Warfighter





WIDA Benefits



- **Mission Planning**

Inject Weather into Key Decisions, Such as Tactics, Weapons Choice, Mission Time

- **Mission Execution**

Enhance Aircrew Situational Awareness with Target-Scene Visualizations and Detection/Lock-On Range Predictions



WIDA Products



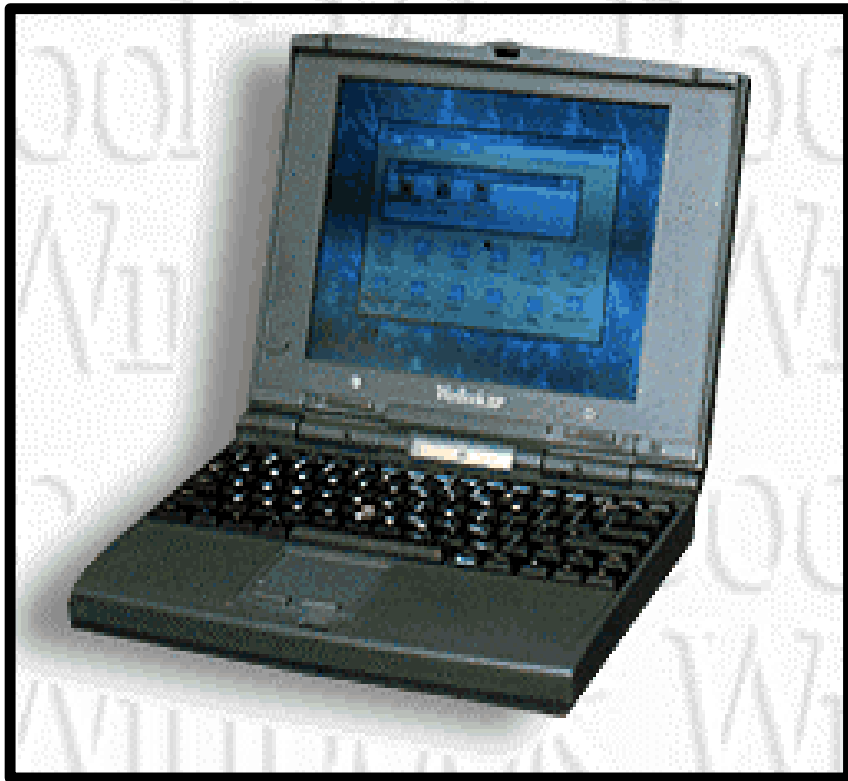
- **Target Acquisition Weather Software (TAWS)**
- **IR Target-Scene Simulation Software (IRTSS)**
- **NVG Operations Weather Software (NOWS)**



Target Acquisition Weather Software (TAWS)



Joint AF/Navy Replacement to Outdated EOTDA



- Target Scene Visualization
- Detection/Lock-on Ranges
- IR, TV, NVG, Laser

Improved Physics

- Windows95/WindowsNT
- Standalone Execution Possible
- Exploit Available Networking

EOTDA = Electro-Optica Tactical Decision Aid



TAWS: Joint AF/Navy Effort



Air Force

- **Over-Land Models**
 - Geographic Backgrounds
 - Targets
 - Atmospheric Effects
- **Scene Visualization**
- **Data Support Technology**

Navy

- **Maritime/Littoral Models**
 - Water Backgrounds
 - Ships
 - Atmospheric Effects

TAWS (EOTDA Replacement)



TAWS Iterative Development



Develop, Field, Get User Feedback

● Beta Version

- Wavebands: 8-12 IR, TV, NVG, laser
- Computes detection/lock-on ranges
- Modern GUI
- Automated Weather Input
- Simple Scene Visualization (EOTDA-equivalent)

● Version 1.0

- Improved 8-12 IR Physics
- Advanced Scene Visualization (8-12 IR)

● Versions 2.0 - 4.0

- 3-5 IR Physics
- Extended Scene Visualization (8-12 IR, 3-5 IR, TV, NVG)
- Extended Target Suite



TAWS Development Schedule



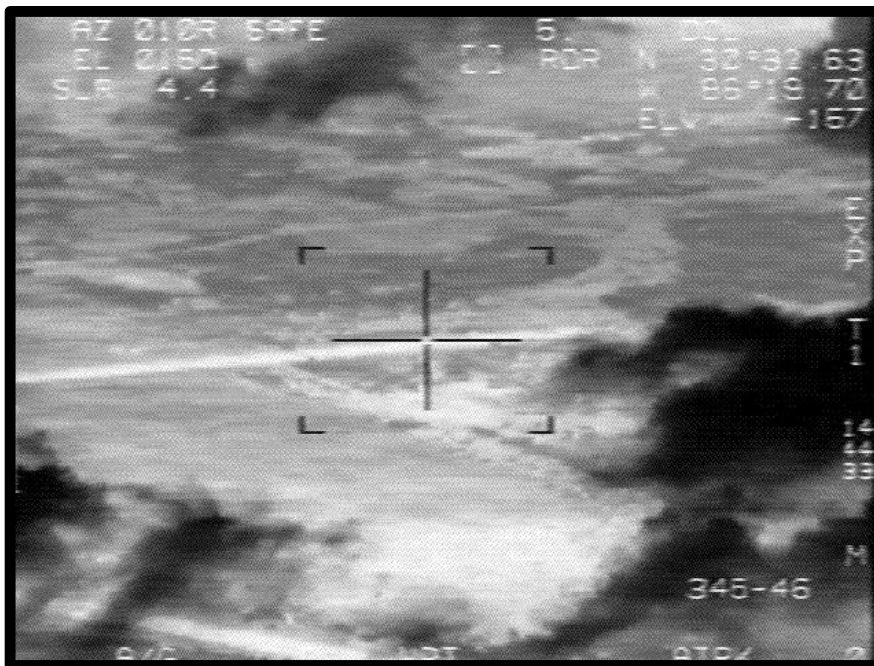
TAWS Beta	Feb 99
TAWS 1.0	Aug 99
TAWS 2.0	Feb 00
TAWS 3.0	Nov 00
TAWS 4.0	Aug 01



IR Target-Scene Simulation Software (IRTSS)



“Through-the-Sensor” Weather Impacted Target Scene Visualization for TAWS



- **Improve Situational Awareness**
- **Optimize Weapon Choice**
- **Optimize Tactics**
- **Improve Target Detection**

Result: Increased Bomb-on-Target Rates



IR Target-Scene Simulation Software (IRTSS)



“Through-the-Sensor” Target Scene Prediction

Based on Mission Time and Forecast Weather

- **Core Software**

- IR Target/Background Radiance Models (SWOE/TCM2)
- Atmospheric Effects Models (MODTRAN and interpolator)
- Sensor Model (in-house)
- Scene Rendering (OpenGL)
- Client/Server Implementation Using Internet Technology

- **Data Handling**

- Geography (based on commercial technology)
- Weather (use operational automated feeds)
- Targets (target builder will extend limited EOTDA target suite)

- **Validation**

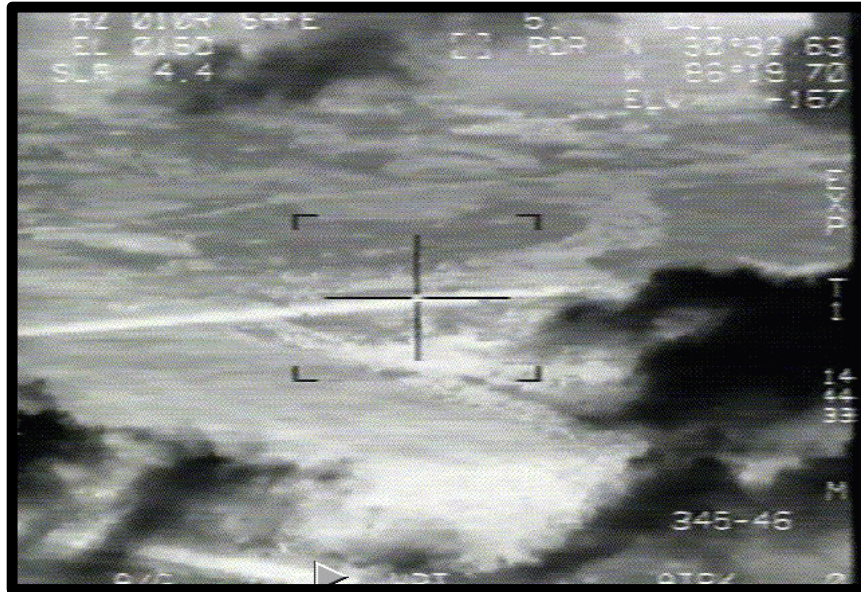
- Field testing at NAS Fallon and Eglin AFB
- Lab testing at Hanscom AFB

- **Transition to AFWA, AFMSS and TAWS**



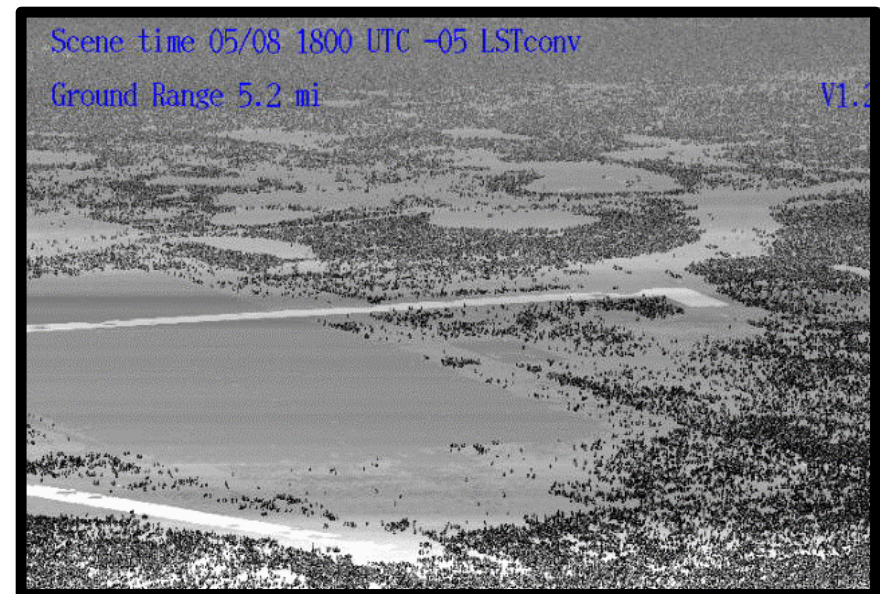
IRTSS Comparison with Cockpit Video

(Eglin AFB, FL)



← **Cockpit Video**
(8-12 micron IR)

IRTSS Synthetic
(8-12 micron IR)



IRTSS correctly captures relative brightnesses of geographic features, such as the runway. Notice the significant geographic detail in the synthetic imagery.

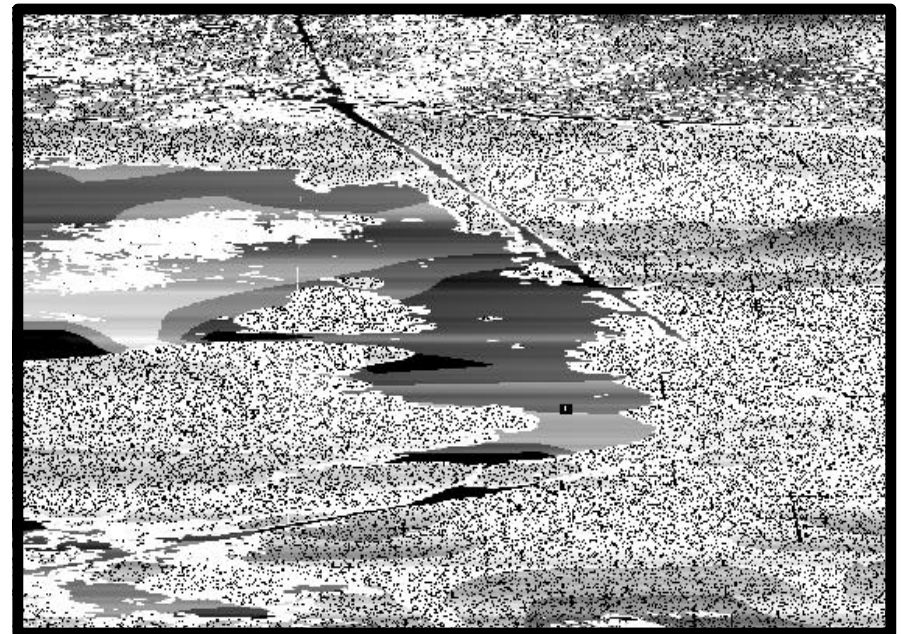


IRTSS Comparison with Cockpit Video (China Lake)



← **Cockpit Video**
(8-12 micron IR)

IRTSS Synthetic
(8-12 micron IR)





IRTSS with Synthetic IR Clouds



*Clouds Generated by AFRL Cloud Scene Simulation Model (CSSM)
(for 8-12 IR waveband)*

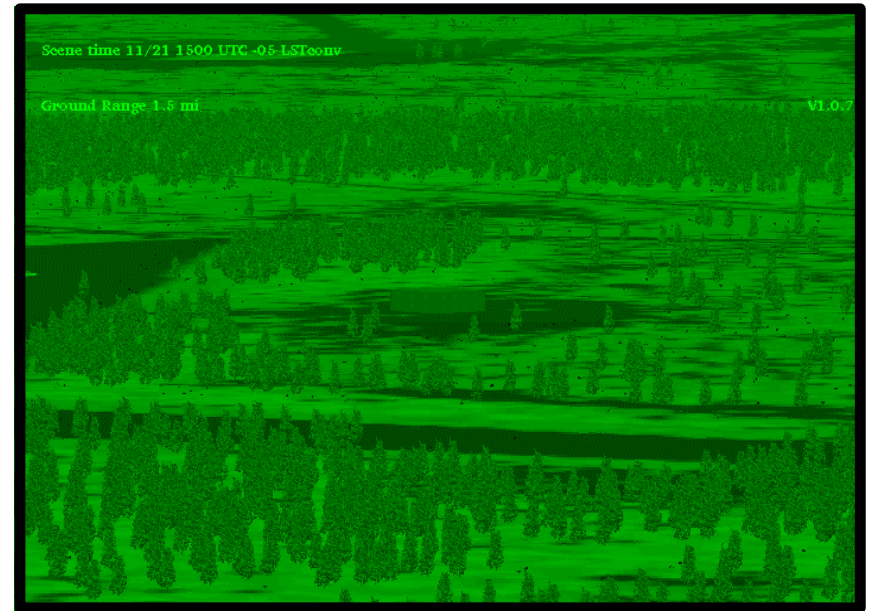
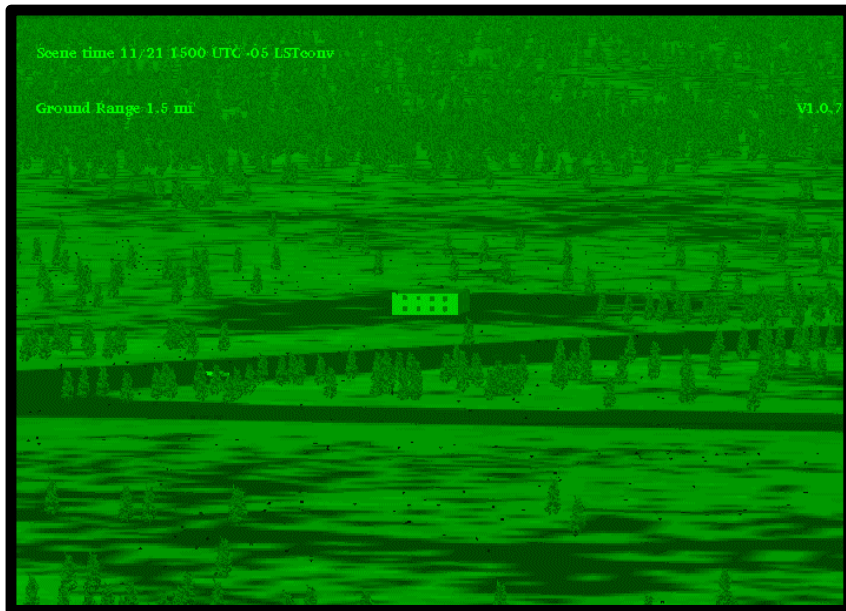




IRTSS for Mission Planning and Situational Awareness



Target-Area Study - Visualize Target/Background Contrast and Geographic Features from Possible Attack Headings

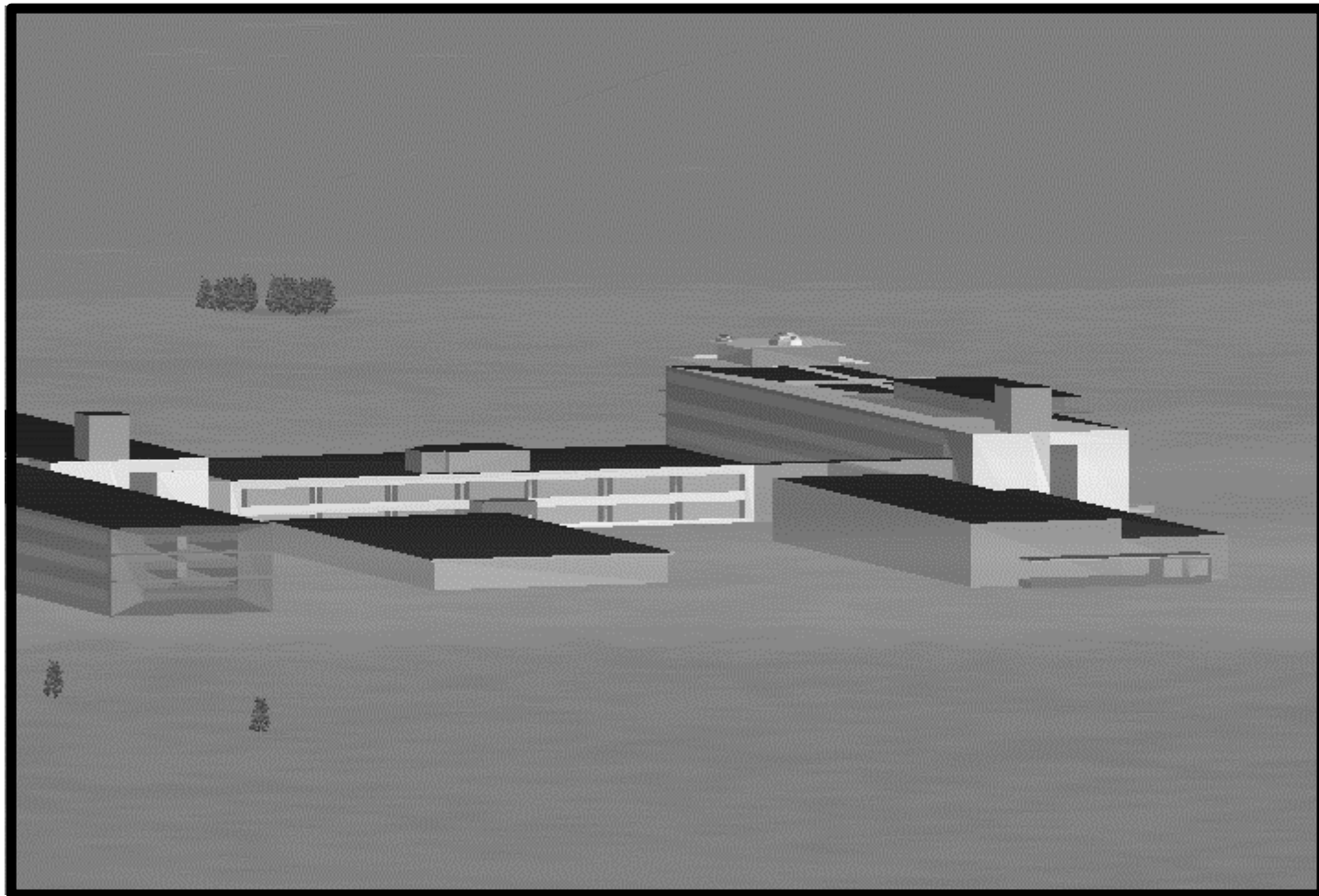




IRTSS and Complex Targets

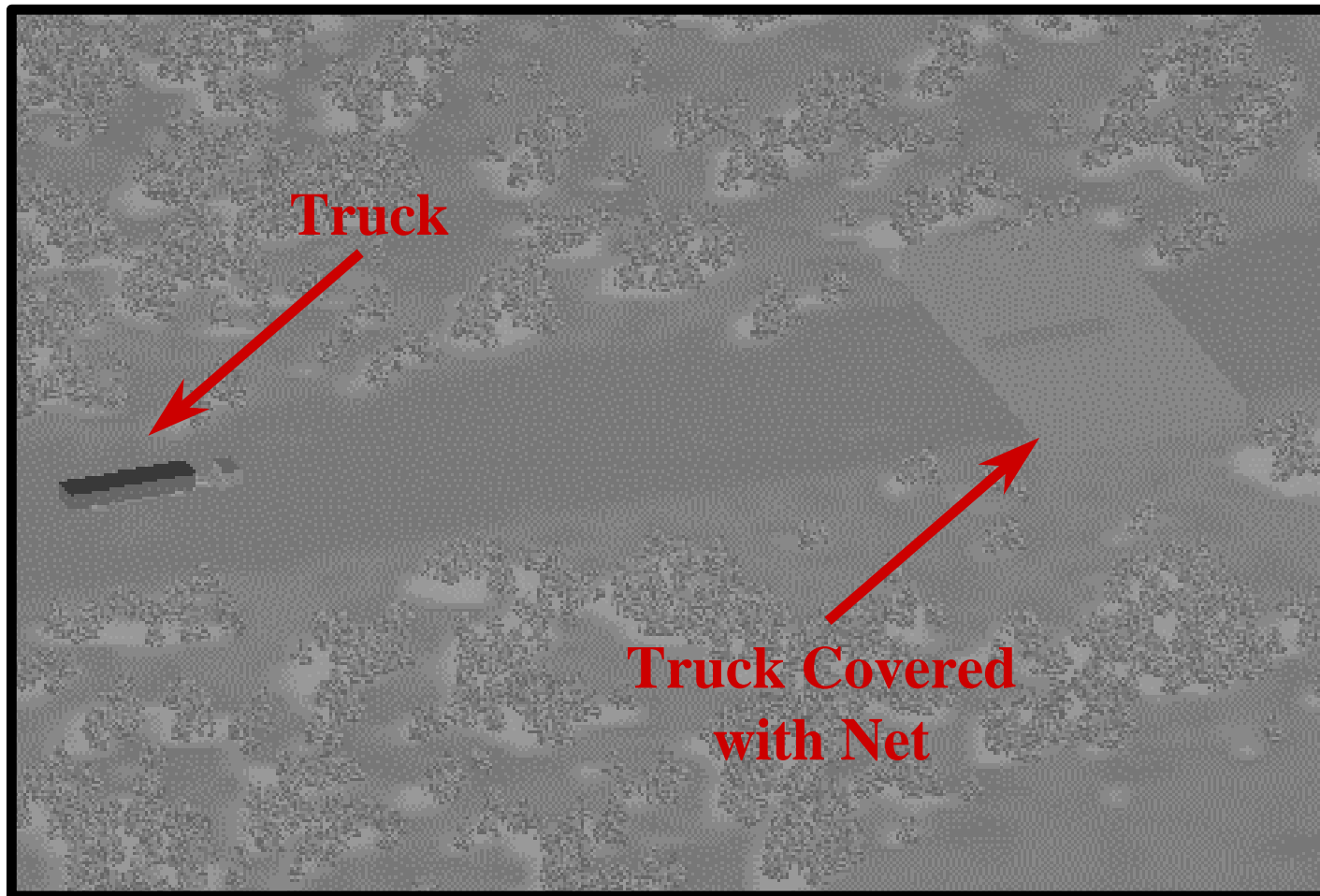


Target Builder Allows Custom Target Thermal Modeling





IRTSS and CCD

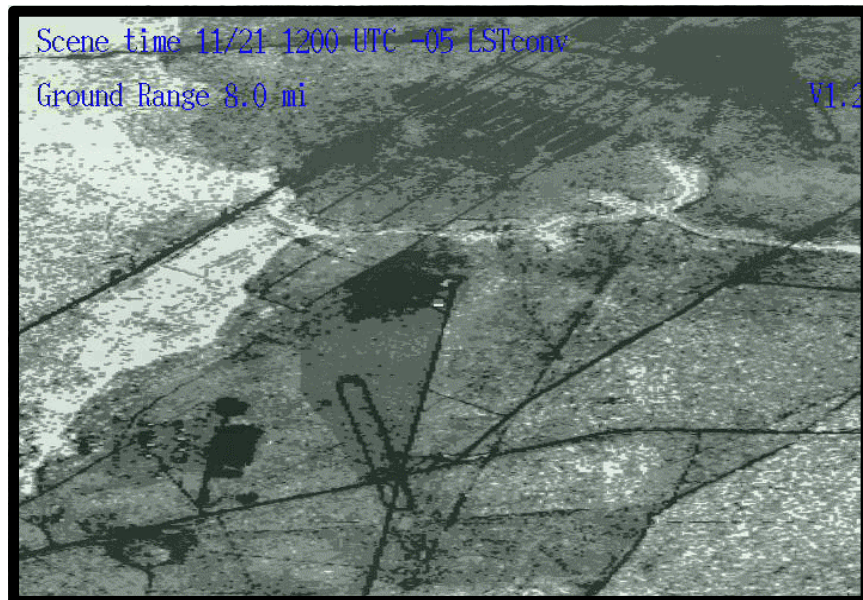




IRTSS Captures Weather Effects



Clear

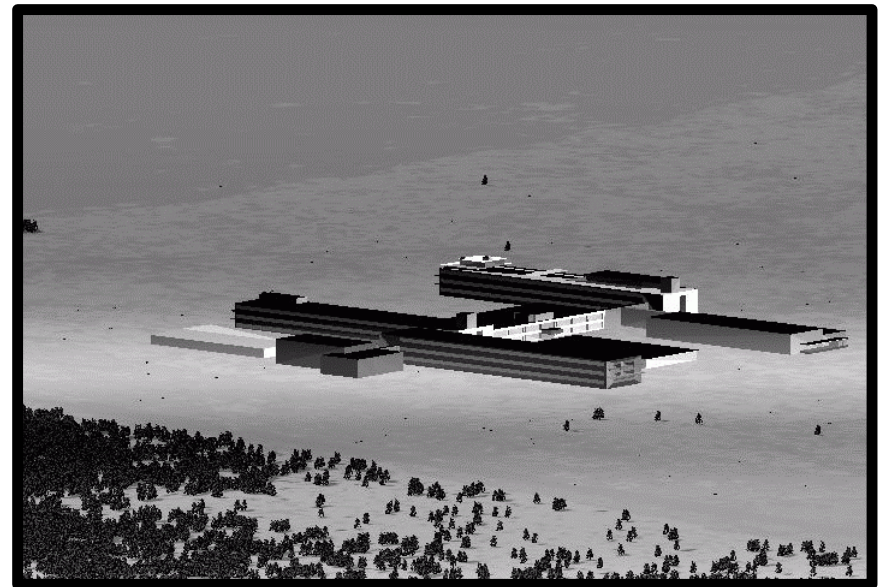
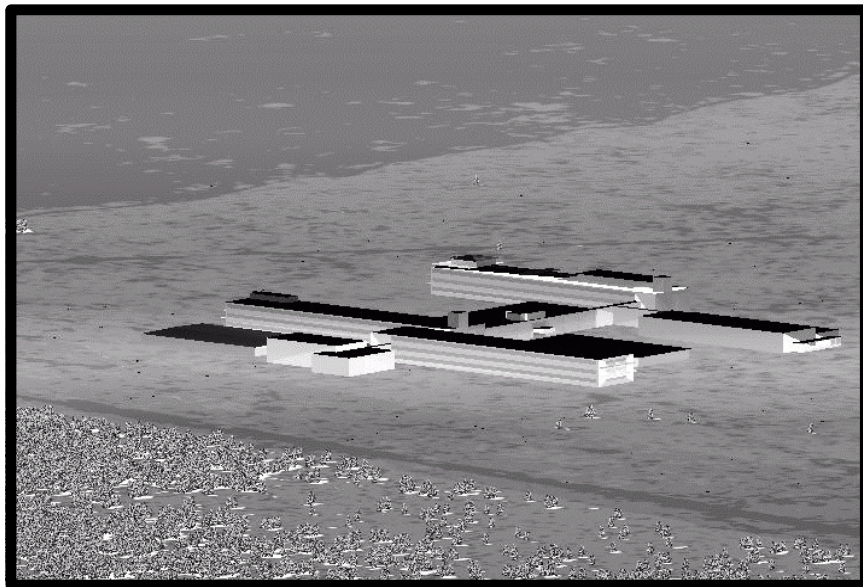


Humid/Windy



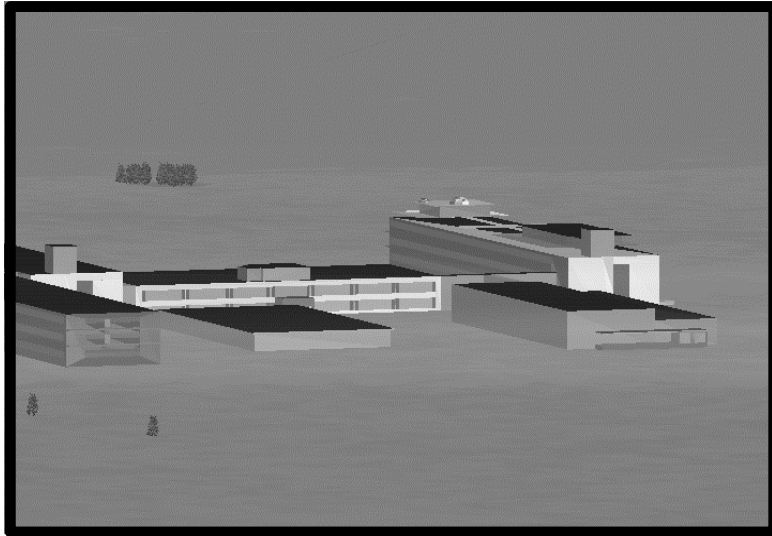


IRTSS Captures Time-of-Day Effects





Putting IRTSS Into TAWS

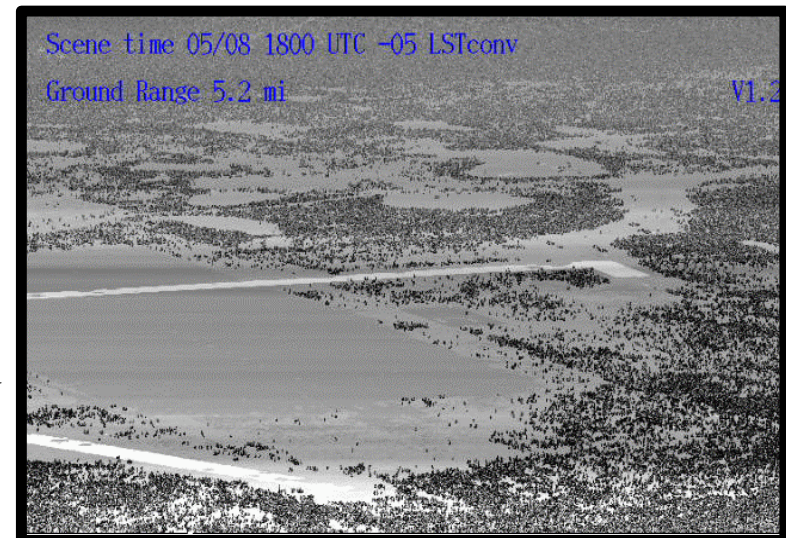


TAWS 1.0 (Aug 99)

Target/shadow contrast against simple background, including atmospheric effects (8-12 IR).

TAWS 2.0 (Feb 00)

Show target position relative to broad geographic features and show target/background contrast (8-12 IR).



TAWS 3.0 and 4.0: Add 3-5 IR, Visible, NVG Scene Predictions

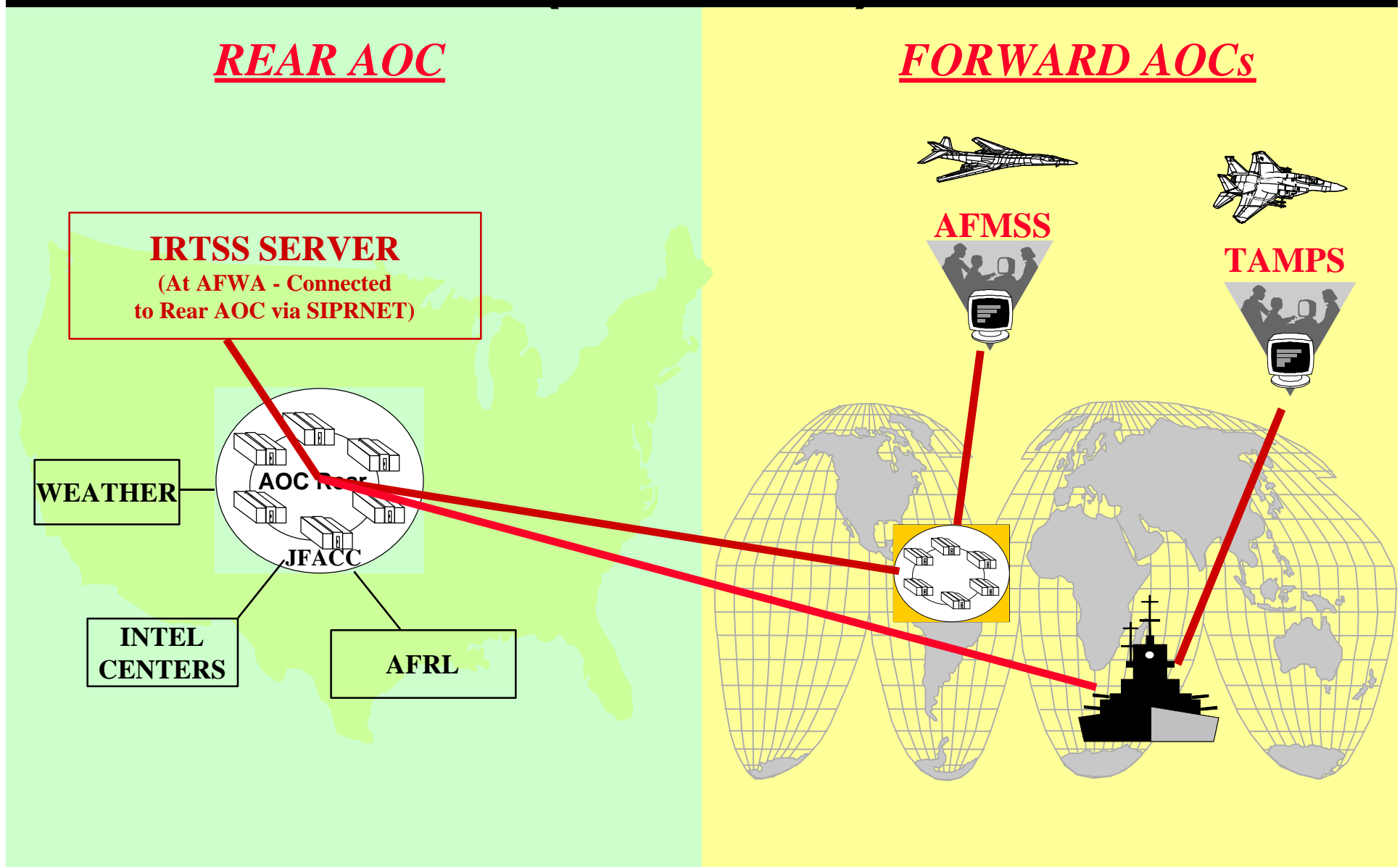


Putting IRTSS on SIPRNET (Fall 1998)



REAR AOC

FORWARD AOCs

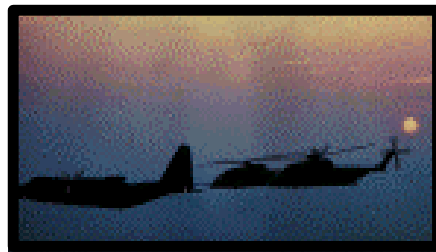




NVG Weather Operations Software (NOWS)



NVG Performance Predictions Using Forecast Weather



- Target Detection Range
- Horizon Visibility
- Laptop PC Operation

Plan Night Airstrikes, Refueling, and Troop Insertion



NOWS Development Schedule



NOWS 1.0	Jan 95 to AFSOC
NOWS 2.0	Nov 95 to AFSOC
NOWS 3.0	Sep 96 to AFSOC, ACC, AFRES
NOWS 4.0	Dec 97 to AFSOC, ACC, AFRES
NOWS 5.0	FY 00



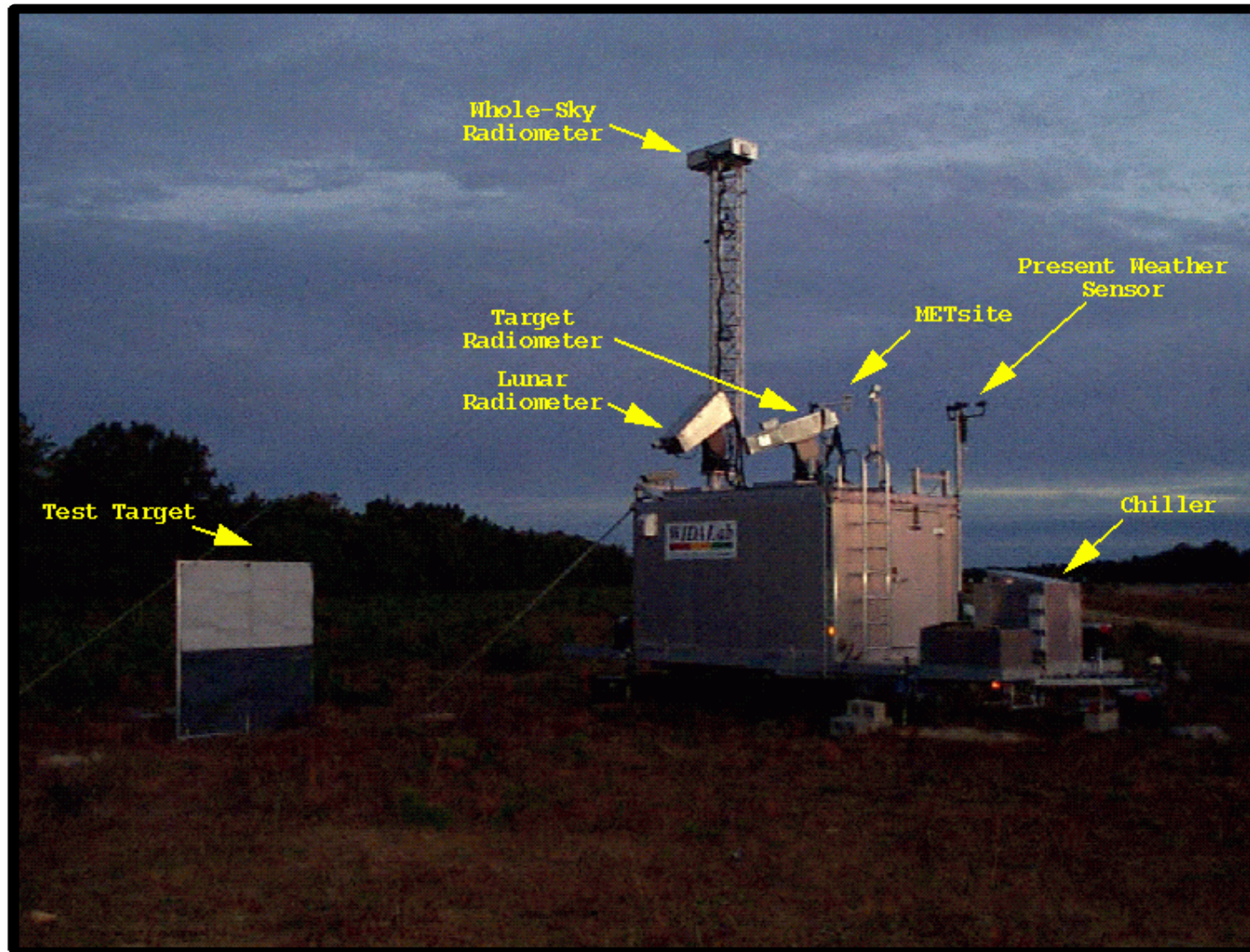
NOWS Progress Summary



- **Version 4.0 Complete**
 - Over 100 copies sent AF-wide to AFSOC, ACC, AFRES
- **Field Validation Initiated**
 - Mobile Data Collection Trailer Operational
 - Conducted 4 2-Week Experiment Episodes on Cape Cod
- **Validation Analysis Initiated**



Mobile NOWS Validation Trailer





The Bottom Line



- **TAWS, IRTSS, NOWS translate information dominance into readily-assimilated situational awareness**
 - ♦ Scene Visualiations
 - ♦ Detection/Lock-On Range Predictions
- **TAWS, IRTSS, NOWS can be provided on field-deployable hardware**